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MONTHLY WEIGHT AND BALANCE REPORT

FOR THE APOLLO SPACECRAFT

CONTRACT NAS 9-150

(U)

PARAGRAPH 8.10, EXHIBIT I
(CCA97)

1 MARCH 1964

Prepared by

Weight Control

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NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

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INTRODUCTION

The March report is the fourth report utilizing the current Airframe 011 drawing release as a basis. The current weight status summarizes the changes from the previous Airframe 011 weight, and incorporates the estimated changes for the LOR Mission Spacecraft. This format allows weight status reporting consistent with airframe release and continuous updating of the estimated LOR changes.

The current report reflects a LOR spacecraft increase of 245 pounds at injection and 105 pounds at injected spacecraft condition less Service Module propellant. The current injected weight of 85,925 pounds is based on a Service Module loaded with sufficient propellant at a specific impulse of 313.0 to provide 10 per cent $\triangle V$ margin. This is based on a LEM weight, including crew, of 25,000 pounds.

The major changes in the Command Module were due to a change in the heat shield attach structure, an increase in webbing thickness for the main parachute harness and the addition of a dual switching panel for control of the Command Module reaction control engines after Service Module separation.

The major changes in the Service Module were due to the addition of a retention reservoir in the sump tank to insure SPS engine starting at zero "G" condition and an increase in RCS engine reflectors and insulation due to the continuous burn requirement of 500 seconds.

The major change in the Launch Escape System was due to an increase in ballast consistent with the combined Launch Escape and Command Module balance requirements.

The Earth Orbital Mission Weight Summary reflects a two stage Booster-to-Orbit injection without the use of Service Module propulsion and is based on a complete Service Module loaded with 2425 pounds of deorbit propellant. The Earth Orbit weight reported limits the orbital altitude capability with the Saturn I booster to 68.4 nautical miles. To obtain the 100 nautical mile orbital altitude with the Saturn I booster requires off loading items from the Command Module and Service Module.

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APOLLO LOR MISSION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT.^{2})		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	10040	1043.8	0.1	6.9	4628	4183	3868
SERVICE MODULE - Less Propellant	9950	908.2	0.3	-0.2	6361	10581	10424
TOTAL - Less Propellant	19990	976.3	0.2	3.4	11043	34652	34126
PROPELLANT - S/M**	38075	906.6	5.0	-2.1	19638	20206	26922
TOTAL - With Propellant	58065	930.6	3.3	-0.2	30831	68690	74860
LUNAR EXCURSION MODULE	24460	623.0	0.1	1.4	13616	12776	13247
ADAPTER - LEM - C-5	3400	642.7	0.0	0.0	8370	12271	12271
TOTAL - Injected	85925	831.6	2.2	0.3	52875	472494	479174
LAUNCH ESCAPE SYSTEM	7275	1295.0	0.0	-0.3	291	12780	12782
TOTAL - SPACECRAFT LAUNCH	93200	867.8	2.1	0.2	53174	796093	802781

NOTES: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the command module substructure mold line.

**The propellant weight of 38075 pounds provides approximately 10% Δ V margin, and is determined from an estimated time line analysis. The propellant weight is based on a specific impulse of 313.0.

APOLLO EARTH ORBIT MISSION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT.^{2})		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	10040	1043.8	0.1	6.9	4628	4183	3868
SERVICE MODULE - Less Propellant	9950	908.2	0.3	-0.2	6361	10581	10424
TOTAL - Less Propellant	19990	976.3	0.2	3.4	11043	34652	34126
PROPELLANT - S/M**	2425	849.0	27.3	-11.5	815	444	564
TOTAL - With Propellant	22415	962.5	3.1	1.8	12304	42764	42598
ADAPTER - C-1	885	778.5	-0.3	-0.5	1058	868	820
TOTAL - Injected	23300	955.5	3.0	1.7	13366	49857	47644
LAUNCH ESCAPE SYSTEM	7275	1295.0	0.0	-0.3	291	12780	12782
TOTAL - Spacecraft Launch	30575	1036.3	2.3	1.2	13672	200531	200326

NOTES: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the command module substructure mold line.

**The earth orbital weights are based on a complete service module and includes 2425 pounds of propellant for an orbital altitude of about 68.4 nautical miles with a payload launch azimuth of 72°.

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APOLLO LAUNCH ABORT CONFIGURATION

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

ITEM	WEIGHT POUNDS	CENTER OF GRAVITY*			MOMENTS OF INERTIA (SLUG-FT.^{2})		
		X	Y	Z	ROLL (X)	PITCH (Y)	YAW (Z)
COMMAND MODULE	10040	1043.8	0.1	6.9	4628	4183	3868
LAUNCH ESCAPE SYSTEM	7275	1295.0	0.0	-0.3	291	12780	12782
TOTAL - Launch Abort	17315	1149.3	0.1	3.9	4966	74464	74104
LESS - MAIN AND PITCH MOTOR PROPELLANTS	-3205	1296.2	0.0	0.0	-69	-1299	-1299
TOTAL - LES Burnout	14110	1116.0	0.1	4.8	4885	54844	54497

NOTES: *Centers of gravity are in the NASA reference system except that the longitudinal axis has an origin 1000 inches below the tangency point of the command module substructure mold line.

COMMAND MODULE

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

LUNAR ORBIT RENDEZVOUS MISSION

VEHICLE MODE	WEIGHT POUNDS	CENTER OF GRAVITY			MASS INERTIA DATA (SLUG-FT.^{2})					
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE, LAUNCH	10040	1043.8	0.1	6.9	4628	4183	3868	-11	-240	-30
ADJUSTMENTS (NET)	-71									
Boost & Mission Coolants										
Food & Water Consumption										
Mission Waste Pickup										
Fuel Cell Water Pickup										
Docking Provisions										
Ablator B/O, Boost										
PRIOR TO ENTRY	9969	1042.8	0.1	7.1	4621	4101	3781	3	-252	-23
Less: Propellant	-135	1022.6	-5.1	56.6						
Ablator Burnoff	-240	1024.4	0.0	12.5						
Entry Coolant	-6	1022.6	-63.4	-16.4						
Forward Heat Shield	-336	1098.3	-0.1	3.4						
Drogue Chutes	-50	1090.0	0.0	-22.0						
PRIOR TO MAIN CHUTE DEPLOYMENT	9202	1041.3	0.3	6.5	4276	3565	3305	-1	-190	-17
Less: Main Chutes (3)	-450	1091.7	-0.3	7.7						
Propellant	-135	1022.6	-5.1	56.6						
LANDING	8617	1038.9	0.4	5.7	4125	3203	2971	-	-172	-9

NOTE: Mass inertia data is shown for accumulative totals only.

COMMAND MODULE + LEV

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

HIGH ALTITUDE ABORT CONDITION

VEHICLE MODE	WEIGHT POUNDS	CENTER OF GRAVITY*			MASS INERTIA DATA (SLUG-FT.^{2})					
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE	10040	1043.8	0.1	6.9	4628	4183	3868	-11	-240	-30
Boost Cover	185	1100.7	0.0	0.0						
LEV Tower	577	1141.1	0.0	-2.4						
C/M, TOWER & COVER	10802	1050.0	0.1	6.3	4758	5643	5320	-12	-360	-30
Less: Boost Coolant	-4	1022.6	-63.4	- 16.4						
Tower Insulation B/O	-104	1142.0	0.0	0.0						
Ablator Burnoff, boost	-54	1032.8	0.0	10.9						
C/M, ABORT PHASE	10640	1049.2	0.1	6.3	4679	5383	5057	-14	-346	-31
Less: Propellant	-135	1022.6	-5.1	56.6						
Entry Coolant	-6	1022.6	-63.4	-16.4						
LEV Tower (At B/O)	-473	1140.9	0.0	-2.9						
Boost Cover	-185	1100.7	0.0	0.0						
Forward Heat Shield	-336	1098.3	-0.1	3.4						
Docking Provisions	-100	1110.3	0.0	0.0						
Drogue Chutes	-50	1090.0	0.0	-22.0						
PRIOR TO MAIN CHUTE DEPLOYMENT	9355	1041.3	0.3	6.5	4387	3668	3406	-15	-174	-26
Less: Main Chutes (3)	-450	1091.7	-0.2	7.7						
Propellant	-135	1022.6	-5.1	56.6						
LANDING	8770	1039.0	0.4	5.7	4235	3306	3072	-15	-156	-18

NOTE: Mass inertia data is shown for accumulative totals only.

COMMAND MODULE

WEIGHT, CENTER OF GRAVITY AND INERTIA SUMMARY

LOW ALTITUDE ABORT CONDITION

VEHICLE MODE	WEIGHT POUNDS	CENTER OF GRAVITY			MASS INERTIA DATA (SLUG-FT.^{2})					
		X	Y	Z	Ixx	Iyy	Izz	Ixy	Ixz	Iyz
COMMAND MODULE, LAUNCH	10040	1043.8	0.1	6.9	4628	4183	3868	-11	-240	-30
Less: Oxidant	-180	1022.6	15.6	62.4						
Forward Heat Shield	-336	1098.3	-0.1	3.4						
Docking Provisions	-100	1110.0	0.0	0.0						
Drogue Chute	-50	1090.0	0.0	-22.0						
PRIOR TO MAIN CHUTE DEPLOYMENT	9374	1041.3	-0.2	6.2	4415	3646	3448	1	-160	-62
Less: Main Chutes (3)	-450	1091.7	-0.3	7.7						
Fuel	-90	1022.6	-46.5	44.9						
LANDING	8834	1038.9	0.3	5.7	4292	3333	3100	-13	-155	-28

NOTE: Mass inertia data is shown for accumulative totals only.

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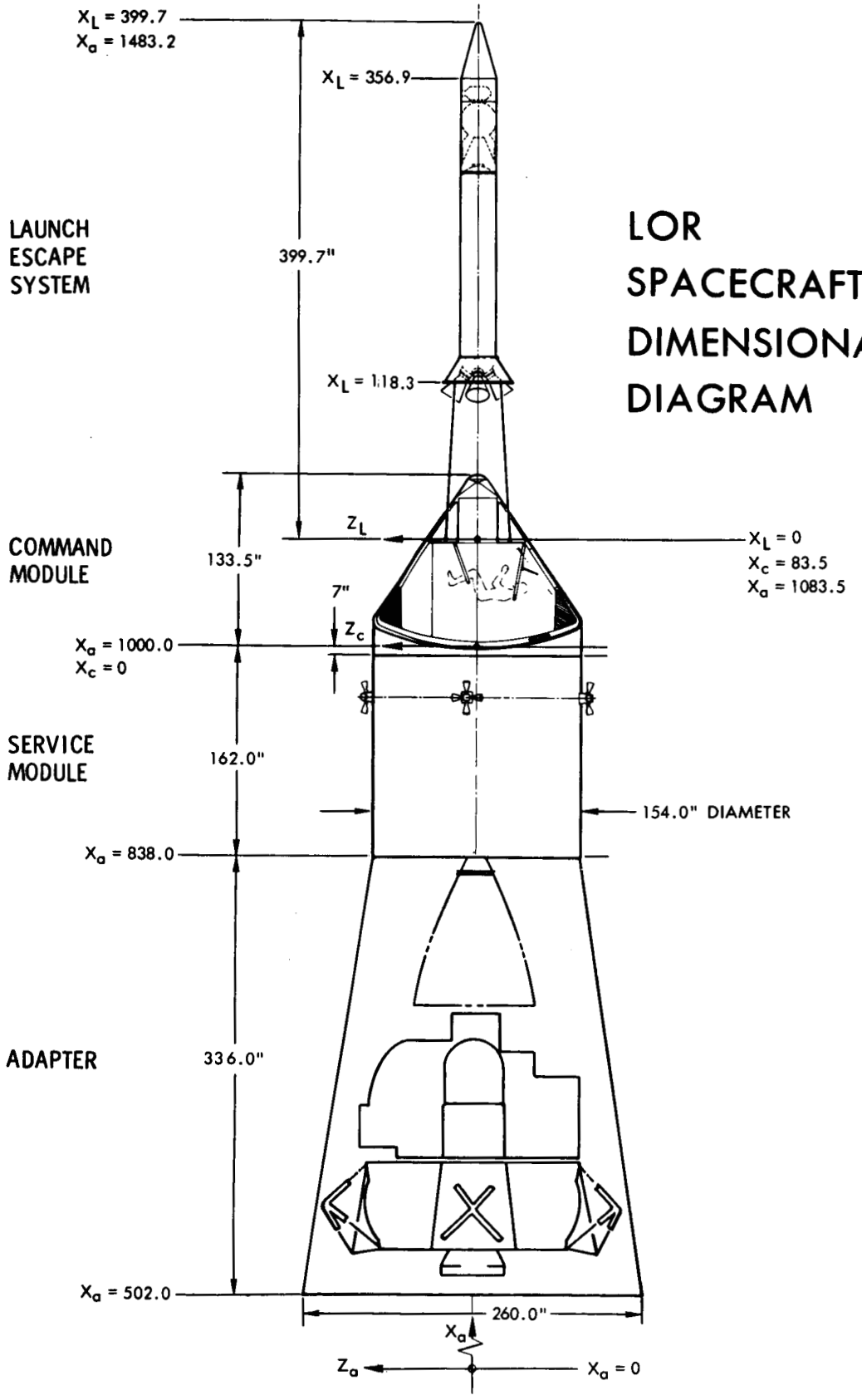
LOR SPACECRAFT DIMENSIONAL DIAGRAM



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SPACECRAFT

WEIGHT STATUS SUMMARY

(LESS LEM)

ITEM	PREVIOUS AFRM 011 STATUS 2-1-64	CHANGE TO CURRENT AFRM	CURRENT AFRM 011 WEIGHT 3-1-64	ESTIMATED CHANGES TO LOR	CURRENT LOR WEIGHT 3-1-64	BASIS FOR CURRENT LOR STATUS		
						%EST	%CAL	%ACT
COMMAND MODULE	10285	+25	10310	-270	10040	38	62	
SERVICE MODULE - B/O	9805	-15	9790	+160	9950	17	73	10
LES	7165	+5	7170	+105	7275	39	52	9
ADAPTER	885		885	+2515	3400	100		
TOTAL LESS PROPELLANT	28140	+15	28155	+2510	30665	38	57	5
PROPELLANT	-	-	-	-	38075		100	
GROSS WEIGHT	-	-	-	-	68740	17	81	2

INJECTED SPACECRAFT

WEIGHT STATUS

ITEM	PREVIOUS LOR STATUS 2-1-64	CHANGE TO CURRENT	CURRENT LOR STATUS 3-1-64
COMMAND MODULE	9990	+50	10040
SERVICE MODULE	9895	+55	9950
ADAPTER	3400		3400
LEM	24460		24460
TOTAL S/C Injected Less Propellant	47745	+105	47850
PROPELLANT	37935	+140	38075
TOTAL INJECTED WEIGHT	85680	+245	85925

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COMMAND MODULE WEIGHT STATUS

ITEM	PREVIOUS AFRM 011 STATUS 2-1-64	CHANGES TO CURRENT AFRM	CURRENT AFRM 011 WEIGHT 3-1-64	ESTIMATED CHANGES TO LOR	CURRENT LOR WEIGHT 3-1-64	BASIS FOR CURRENT LOR STATUS		
						%EST	%CAL	%ACT
Structure	(4751)	(+19)	(4770)	(-71)	(4699)			
Structure - Less Ablator	3398	+19	3417	+ 9	3426	15	85	
Ablation Material	1353		1353	-80	1273	100		
Stabilization & Control	253	- 5	248	-22	226	14	86	
Guidance & Navigation	441		441	-10	431	54	46	
Crew Systems	387		387		387	19	81	
Environmental Control	288		288	- 7	281	27	73	
Earth Landing System	692	+13	705		705	13	84	3
Instrumentation	669	-10	659	-395	264	48	52	
Electrical Power	533		533	-14	519	83	17	
Reaction Control	327	+12	339		339	62	38	
Communications	361		361	- 9	352	24	76	
Controls & Displays	327	- 4	323	-24	299	20	80	
WEIGHT EMPTY	9029	+25	9054	-552	8502	38	62	-
Scientific Equipment	-		-	+250	250	100		
Crew Systems	835		835	+33	868	39	61	
Reaction Control	270		270		270		100	
Environmental Control	151		151	-1	150		100	
GROSS WEIGHT	10285	+25	10310	-270	10040	38	62	

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COMMAND MODULE

CURRENT AIRFRAME WEIGHT EMPTY CHANGES

STRUCTURE		(+19.0)
Decrease inner structure forward section due to transferring the forward pitch engine support assembly to the heat shield substructure forward section per analyses of released drawings.		-4.0
Increase secondary structure due to the following:		+13.0
Increase of RH equipment bay panels due to the redesign required to accommodate electrical wiring.	+4.0	
Addition of brackets to main display panel to meet current structural requirements.	+1.0	
Increase in lower equipment bay based on calculated in lieu of estimated weights for the clothing compartment, and the telescope and sextant eyepiece door.	+4.0	
Increase in aft equipment bay due to the addition of tees and fittings required to support relocated equipment.	+1.0	
Increase in aft heat shield equipment area due to calculation of released drawings reflecting additional support tees.	+3.0	
Increase heat shield substructure forward section due to transferring the forward pitch engine support assembly and redesigning the support structure to reduce affect of riser impact.		+5.0
Decrease heat shield substructure forward section honeycomb panels due to chem-milling honeycomb face sheets on the nose cap.		-5.0
Increase heat shield substructure center section due to the following:		+7.0
Increase of honeycomb panels and closeouts due to calculation of edge member redesign in lieu of estimated.	+2.0	
Increase of frames and rings due to a change in inner to outer attach structure in the heat shield equipment area based on revised abort load analysis.	+10.0	

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COMMAND MODULE

CURRENT AIRFRAME WEIGHT EMPTY CHANGES

STRUCTURE (Continued)	
Decrease in the number of frames in the heat shield equipment area as a result of the crushable impact core installation.	-5.0
Increase heat shield substructure aft section due to adding an oxidizer dump fitting to the aft heat shield.	+3.0
STABILIZATION & CONTROL	(-5.0)
Decrease wiring and connectors based on current wire measurement list.	-5.0
EARTH LANDING SYSTEM	(+13.0)
Increase webbing thickness of the main parachute harness assembly per strength requirements as reported by Northrop-Ventura's current status report.	+9.5
Increase main parachute pack due to the addition of cutters and reefing line required for redundant reefing per current Northrop Ventura status report.	+1.5
Increase forward heat shield release system due to incorporation of calculated in lieu of estimated weights for the breach.	+1.4
Increase drogue disconnect installation due to changing the cutter blade material to inconel 718 per current Northrop Ventura status report.	+0.6
INSTRUMENTATION	(-10.0)
Delete nuclear radiation detection equipment as the current Airframe 011 Mission does not include this requirement.	-17.0
Increase wiring and connectors based on current wire measurement lists.	+7.0

[redacted]

[redacted]

COMMAND MODULE

CURRENT AIRFRAME WEIGHT EMPTY CHANGES

REACTION CONTROL	(+12.0)
Decrease fuel system tank and expulsion devices per vendor status changing the design to make the tanks compatable with the Service Module RCS expulsion system.	-1.1
Increase electrical provisions due to the addition of a dual switching panel for control of the Command Module RCS after Service Module separation based on current wire calculations.	+13.1
CONTROLS AND DISPLAYS	(-3.0)
Delete the nuclear radiation display as the current Airframe 011 mission does not include this requirement.	-3.0
Decrease manual rotational control based on calculation of detail parts.	-1.0
TOTAL COMMAND MODULE CURRENT AIRFRAME WEIGHT EMPTY CHANGES	+25.0

[redacted]

SERVICE MODULE WEIGHT STATUS

ITEM	PREVIOUS AFRM 011 STATUS 2-1-64	CHANGES TO CURRENT AFRM	CURRENT AFRM 011 WEIGHT 3-1-64	ESTIMATED CHANGES TO LOR	CURRENT LOR WEIGHT 3-1-64	BASIS FOR CURRENT LOR STATUS		
						%EST	%CAL	%ACT
Structure	2245	-25	2220	+70	2290	11	74	15
Environmental Control	92		92		92	20	79	1
Instrumentation	172	+2	174	-61	113	30	70	
Electrical Power	1397		1397	-8	1389	12	40	48
Propulsion System	(3038)	(+25)	(3063)		(3063)			
Engine Installation	715	-3	712		712	50	50	
Propulsion System	2323	+28	2351		2351	13	87	
Reaction Control	580	+22	602		602	61	39	
Communications	51	-39	12	+39	51	100		
Rendezvous Radar				+120	120	100		
WEIGHT EMPTY	7575	-15	7560	+160	7720	22	65	13
RCS Propellant	838		838		838		100	
Electrical Power Super. Fluids	503		503		503		100	
Environmental Contr. Super. Fluids	208		208		208		100	
Main Propulsion Helium	99		99		99		100	
Main Propulsion Residuals	(582)		(582)		(582)		100	
Trapped - System	225		225		225			
Trapped - Engine	67		67		67			
Mixture Ratio Tolerance	100		100		100			
Loading Tolerance	190		190		190			
BURNOUT WEIGHT	9805	-15	9790	+160	9950	17	73	10
Main Propellant					38075		100	
GROSS WEIGHT					48025	4	94	2

[redacted]

SERVICE MODULE

CURRENT AIRFRAME WEIGHT EMPTY CHANGES

STRUCTURE	(-25.0)
Increase fittings and attaching parts based on revised hardware requirements to mount outer shell panels, radial beams and bulkheads.	+5.0
Delete antenna support structure for the high gain antenna as the current Airframe 011 configuration does not include this requirement.	-30.0
INSTRUMENTATION	(+2.0)
Increase electrical wiring and connectors based on current wire measurement lists.	+2.0
MAIN PROPULSION	
Decrease propellant system supports due to removal of zero "g" can.	-4.0
Increase propellant system due to addition of a retention reservoir "positive expulsion can" in the sump tank to insure SPS engine starting	+43.0
Decrease engines based on a vendor status reflecting a change in nozzle stiffness and actuators	-3.0
Decrease electrical provision based on current wire measurement list	-11.0
REACTION CONTROL	(+22.0)
Increase propellant system tanks and expulsion devices per vendor status reflecting increased internal expulsion hardware and bladders.	+8.0
Increase propellant system quantity gaging system per vendor status reflecting increased attachments and protection.	+17.0
Increase engines per vendor status reflecting increased heat sink for injector heads.	+4.8

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SERVICE MODULE

CURRENT AIRFRAME WEIGHT EMPTY CHANGES

REACTION CONTROL (Cont)	
Increase engine system reflectors and insulation due to a NASA direction to provide the capability of emergency retrograde from earth orbit using the SM RCS engines which necessitates increasing the continuous burn requirement for the SM RCS engine from 60 seconds to 500 seconds.	+20.0
Decrease electrical provisions based on current wire measurement list.	-27.8
COMMUNICATIONS	(-39.0)
Delete the high gain antenna and actuating mechanism as the current airframe 011 does not include this requirement.	-39.0
TOTAL CURRENT SERVICE MODULE AIRFRAME WEIGHT EMPTY CHANGES	-15.0

[redacted]

[redacted]

LAUNCH ESCAPE SYSTEM

WEIGHT STATUS

ITEM	PREVIOUS AFRM 011 STATUS 2-1-64	CHANGE TO CURRENT AFRM	CURRENT AFRM 011 WEIGHT 3-1-64	ESTIMATED CHANGES TO LOR	CURRENT LOR WEIGHT 3-1-64	BASIS FOR CURRENT LOR STATUS		
						%EST	%CAL	%ACT
Structure	1031	+2	1033		1033	7	77	16
Electrical System	102		102		102	17	83	
Propulsion System								
Main Thrust	4767		4767		4767	40	60	
Jettison	434		434		434			100
Jettison Motor Skirt	92		92		92			100
Pitch Control	47		47		47	60	40	
Separation Provisions	49		49		49	61	39	
C/M Boost Prot. Cover				+185	185	100		
LES - NO BALLAST	6522	+2	6524	+185	6709	34	56	10
BALLAST	643	+3	646	-80	566	100		
TOTAL L.E.S.	7165	+5	7170	+105	7275	39	52	9

[redacted]

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LAUNCH ESCAPE SYSTEM

CURRENT AIRFRAME CHANGES

STRUCTURE	(+2)
Increase tower aerodynamic flap due to revising insulation bonding and increasing the thickness of the lands.	+2
BALLAST	(+3)
Increase ballast consistent with current Command Module and LES balance requirements.	+3
TOTAL LAUNCH ESCAPE SYSTEM CURRENT AIRFRAME WEIGHT CHANGES	+5

[redacted]

ADAPTER

WEIGHT STATUS

ITEM	PREVIOUS AFRM 011 STATUS 2-1-64	CHANGE TO CURRENT AFRM	CURRENT AFRM 011 WEIGHT 3-1-64	ESTIMATED CHANGE TO LOR	CURRENT LOR WEIGHT 3-1-64	BASIS FOR CURRENT LOR STATUS		
						%EST	%CAL	%ACT
Structure	709		709	+2361	3070			
Electrical	20		20	+60	80			
Separation System	156		156	+ 94	250			
TOTAL ADAPTER	885		885	+2515	3400	100		

[redacted]

COMMAND MODULE

CURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LOR

STRUCTURE	(-71)
Eliminate the heat shield substructure face sheet pads (scar weight) provided on the first few spacecrafts for designs that were not consummated (strakes, plugs, vents, etc.).	-26
Analyze structure design in detail based on a refinement of loading conditions, as the original design was accomplished on an extremely tight schedule utilizing a minimum of loads and equipment information.	-40
Incorporate a boost protection cover over the Command Module nose to be jettisoned with the Launch Escape System tower. This would allow the ablative material thickness on the nose to be reduced.	-30
Reduce the spacecraft temperature criteria from 250°F to 200°F. A saving of approximately one pound of ablative material can be removed for every degree reduction at start of entry.	-50
Refine secondary structure design by additional machining of extrusions utilized in coldplate closeouts, alternate materials, and a reduction of supports for scientific equipment.	-60
Reduce heat shield window glass thickness from 0.70 inch to 0.55 inch based on a more detailed thermal and structural analysis.	-10
Decrease umbilical installation structure due to removing the added umbilical required for airframe instrumentation as the LOR wiring requirements have not been defined at this time.	-5
Add LEM docking provisions for the LOR mission.	+150
STABILIZATION AND CONTROL	(-22)
Remove all elapsed time indicators prior to flight.	-1
Utilize partial potting in low dissipation ECA modules.	-5

[redacted]

COMMAND MODULE

CURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LOR

STABILIZATION AND CONTROL (Cont.)	
Reduce total length of ECA package. Packages are presently designed to include growth capabilities.	-3
Delete multiple monitor relays in DC amplifiers.	-1
Decrease electrical wiring due to utilizing thin wall teflon insulation where possible and reducing wire gage based on electrical load analysis.	-12
GUIDANCE AND NAVIGATION	(-10)
Decrease electrical wiring due to utilizing thin wall teflon insulation where possible and reducing wire gage based on electrical load analysis.	-10
ENVIRONMENTAL CONTROL	(-7)
Utilize a combined tank with separate compartments for waste water and potable water.	-4
Delete re-entry backup oxygen system as the LOR vehicle has the requirement to carry one PLSS which may be utilized for backup.	-3
INSTRUMENTATION	(-395)
Delete instrumentation required for flight qualification.	-305
Decrease electrical wiring due to utilizing thin wall teflon insulation where possible, reducing wire gage based on electrical load analysis and reducing instrumentation wiring by utilizing unshielded wire where possible.	-107
Add Nuclear Radiation Detection required for the lunar vehicle that was previously assumed to be on Airframe 011.	+17

[redacted]

COMMAND MODULE

CURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LOR

ELECTRICAL POWER	(-14)
Decrease umbilical due to deleting extra umbilical added on early airframes as the LOR wiring requirements have not been defined at this time.	-14
COMMUNICATIONS	(-9)
Decrease electrical wiring due to utilizing thin wall teflon installation where possible and reducing wire gage based on electrical load analysis.	-9
CONTROLS AND DISPLAYS	(-24)
Reduce weight of displays by utilizing lamps in lieu of the barometric pressure indicator and by sharing cryogenic pressure and quantity readouts between the hydrogen and oxygen requirements.	-4
Delete the self-test capability of the SCS displays.	-2
Delete tail-off switch from delta V indicator.	-1
Delete present reaction jet solenoid power switching relays from the SCS mode select panel. Utilize a manual switch and circuit breakers for reaction jet solenoid power control.	-2
Replace roll attitude error needle servo drive with galvanometer movement.	-1
Add rendezvous radar panel required for LOR mission.	+13
Delete console interface connectors resulting in some complications in manufacturing and repair of console.	-9
Decrease electrical wiring due to utilizing thin wall teflon insulation where possible and reducing wire gage based on electrical load analysis.	-21
Add Nuclear Radiation Displays required for the lunar vehicle that was previously assumed to be on Airframe 011.	+3
TOTAL COMMAND MODULE CURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LOR	-552

[redacted]

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COMMAND MODULE

CURRENT ESTIMATED USEFUL LOAD CHANGES TO LOR

SCIENTIFIC EQUIPMENT	(+250)
Add scientific equipment based on current LOR mission requirements.	+250
CREW SYSTEMS	(+33)
Reduce life rafts due to design refinement utilizing higher strength to weight ratio materials.	-9
Add one portable life support system to the LOR vehicle as the requirement for this still exists.	+42
ENVIRONMENTAL CONTROL	(-1)
Delete re-entry oxygen required for airframes that do not carry a portable life support system.	-1
TOTAL COMMAND MODULE CURRENT ESTIMATED USEFUL LOAD CHANGES TO LOR	+282

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SERVICE MODULE

CURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LOR

STRUCTURE	(+70)
Add structural beef-up required to support the rendezvous radar equipment.	+40
Add structural provisions for supporting the high gain antenna, previously assumed to be on Airframe 011.	+30
INSTRUMENTATION	(-61)
Decrease electrical wiring due to utilizing thin wall teflon insulation where possible and reducing wire gage based on electrical load analysis.	-61
ELECTRICAL POWER	(-8)
Decrease umbilical due to deleting extra umbilical added on early airframes as the LOR wiring requirements have not been defined at this time.	-8
COMMUNICATIONS	
Add high gain antenna required for deep space communications. This item was previously assumed to be in Airframe 011.	+39
RENDEZVOUS RADAR	(+120)
Add rendezvous radar equipment consistent with the LOR requirements.	+120
TOTAL SERVICE MODULE CURRENT ESTIMATED WEIGHT EMPTY CHANGES TO LOR	+160

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LAUNCH ESCAPE SYSTEM

CURRENT ESTIMATED WEIGHT CHANGES TO LOR

STRUCTURE	(+185)
Add a boost heat shield for portection of the forward compartment during boost heating. The addition of the boost heat shield reduces the forward compartment heat shield ablative thickness and lightens the injected spacecraft weight.	+185
BALLAST	(-80)
Decrease ballast consistent with current Command Module LES balance requirements	-80
TOTAL LAUNCH ESCAPE SYSTEM CURRENT ESTIMATED WEIGHT CHANGES TO LOR	+105

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ADAPTER

CURRENT ESTIMATED WEIGHT CHANGES TO LOR

Utilize the S-IV B Adapter consistent with the current LOR mission requirements in lieu of the S-IV Airframe 011 Adapter	+2515

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WEIGHT HISTORY COMMENTS

LAUNCH ESCAPE SYSTEM

The design goal established for the LES is 6,300 pounds, excluding ballast. This weight was based on the September 1962 status weight of 6,600 pounds, including the necessary ballast to provide currently determined aerodynamic stability to prevent tumbling.

The original design goal of 5,900 pounds, as reported in the June status, SID 62-99-5, was based on an attitude controlled configuration. The current configuration weight includes a pitch motor and ballast not included in the original target weight.

COMMAND MODULE

The design goal established for the Command Module is 8,500 pounds. An estimated weight breakdown for the design goal is provided for comparative purposes.

The original design goal weight of 8,340 pounds, as reported in the June status, SID 62-99-5, did not include the proposed increases nor the Category I reductions presented in the July briefing and incorporated in the July Status Report.

SERVICE MODULE

The design goal established for the Service Module less usable propellant is 11,000 pounds. An estimated weight breakdown for the design goal is provided for comparative purposes. This configuration is sized for 45,000 pounds usable propellant for the 25,000 pound LEM.

The original design goal weight of 8,595 for the burnout condition was based on lunar configuration sized for 31,000 pounds usable propellant.

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WEIGHT HISTORY

COMMAND MODULE

ITEM	DESIGN GOAL	AUTHORIZED CHANGES	DESIGN GOAL ADJUSTED 3-1-64
Structure	3824	+277	4101
Stabilization & Control	181		181
Guidance & Navigation	261	+162	423
Crew System	530		530
Environmental Control	235	-11	224
Earth Landing System	610		610
Instrumentation	173	+7	180
Electrical Power	390	+9	399
Reaction Control	195		195
Communication	330	+33	363
Controls & Displays	261	+13	274
WEIGHT EMPTY	6990	+490	7480
Scientific Equipment	250		250
Crew	528		528
Suits & Personal Equipment	304	-8	296
Food & Containers	90		90
Reaction Control Propellant	210		210
Environmental Control Fluids	128		128
GROSS WEIGHT	8500	+482	8982

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COMMAND MODULE WEIGHT HISTORY

WEIGHT EMPTY AUTHORIZED CHANGES

STRUCTURE	(+277)
Change parachute attach to a two leg configuration for incorporation of the "Tumbling Concept" at earth impact attenuation. (CCA No. 93)	+125
Delete the extendable heat shield window covers and replace current windows with high temperature glass consisting of (3) parallel glass panes. (CCA No. 105)	+2
Add LEM docking provisions for LOR.	+150
GUIDANCE & NAVIGATION	(+162)
Increase the Guidance and Navigation per recent weight report from MIT. Since NAA does not have weight control responsibility for the MIT design, the weight changes in their Weight and Balance Report will be considered as authorized changes.	+162
ENVIRONMENTAL CONTROL	(-11)
Add a CO_2 sensor to the ECS as a part of the ECS operational instrumentation. (CCA No. 43)	+3
Add a surge tank to ECS and delete entry oxygen supply to provide early mission emergency gas flows. (CCA No. 52)	-7
Deletion of regenerative heat exchanger from the ECS heat exchanger package. (CCA No. 63)	-7
Decrease pressure suit gas flow requirement for ventilation flow from 12 CFM to 10 CFM. (CCA No. 123)	+1
INSTRUMENTATION	(+7)
Increase the PCM output bit rate from 31,000 to 51,200 bit/sec. This change was originally considered to have negligible weight affect but has henceforth been reported by Collins to cause a seven pound increase. (CCA No. 44)	+7

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COMMAND MODULE WEIGHT HISTORY

WEIGHT EMPTY AUTHORIZED CHANGES

ELECTRICAL POWER	(+9)
Add two batteries to provide a source of power, separate from the primary D.C. power, to initiate pyrotechnic devices. (CCA No. 28)	+10
Delete automatic LES tower ejection function from flight sequencer for normal missions. (CCA No. 91)	-1
COMMUNICATIONS	(+33)
Add a spacecraft up-data link for the purpose of providing current GOSS data within the spacecraft for display and comparison with the on-board computed data. (CCA No. 54)	+35
Change the present two speed data storage to a three speed machine to provide fast dump of data. (CCA No. 59)	-2
CONTROLS & DISPLAYS	(+13)
Furnish and install a clock timer panel at the navigation station lower equipment bay. (CCA No. 84)	+2
Decrease G & N navigation controls coded to controls and displays per MIT status.	-2
Add rendezvous radar for LOR.	+13
TOTAL COMMAND MODULE WEIGHT EMPTY CHANGES	+490

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COMMAND MODULE WEIGHT HISTORY

USEFUL LOAD AUTHORIZED CHANGES

SUITS & PERSONAL EQUIPMENT		(-8)
Change the following GFE (NASA) responsibility items:		
Increase personal radiation dosimeters per NASA Crew Systems Meeting Number 19, Action Item Number 6.	+10	
Increase PLSS per Hamilton Standard status.	+36	
Delete initial charge water for coolant, from PLSS, as this item is now carried in the potable water tank.	-5	
Delete one PLSS consistent with requirements for LOR mission.	-48	
Delete primary oxygen from remaining PLSS.	-1	
TOTAL COMMAND MODULE USEFUL LOAD CHANGES		-8

[redacted]

[redacted]

WEIGHT HISTORY

SERVICE MODULE

ITEM	DESIGN GOAL	AUTHORIZED CHANGES	DESIGN GOAL ADJUSTED 3-1-64
Structure	3203	+40	3243
Environmental Control	250		250
Instrumentation	100		100
Electrical Power	1203		1203
Propulsion System			
Engine Installation	606		606
Propellant System	2456		2456
Reaction Control	737		737
Communications	45		45
Rendezvous Radar		+120	120
WEIGHT EMPTY	8600	+160	8760
Usable RCS Propellant	611		611
Usable Fuel Cell Reactants	479		479
Environmental Control Fluids	193		193
Main Propulsion Helium	139		139
Main Prop. Residuals	900		900
Unusable RCS Propellant	61		61
Unusable Fuel Cell Reactants	17		17
BURNOUT WEIGHT	11000	+160	11160
Main Propellant	45000		45000
GROSS WEIGHT	56000	+160	56160

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SERVICE MODULE WEIGHT HISTORY

WEIGHT EMPTY AUTHORIZED CHANGES

STRUCTURE	(+40)
Add structural beef-up required to support the rendezvous radar equipment.	+40
RENDEZVOUS RADAR	(+120)
Add rendezvous radar equipment consistent with the LOR requirements.	+120
TOTAL SERVICE MODULE WEIGHT EMPTY CHANGES	+160

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POTENTIAL WEIGHT CHANGES

COMMAND MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
STRUCTURE	(+219)	(-183)
Increase ablator consistent with current AVCO status. NAA is currently studying AVCO's ablator thicknesses and densities versus new heating rates.	+194	+194
Increase honeycomb bonding due to a change in adhesive bonding specification for the Apollo spacecraft requiring increases in the bonding thicknesses in the splicing areas.	+25	+25
Decrease ablator due to adding a full boost protective cover eliminating boost ablator and adding thermal paint reducing entry temperatures.		-185
Redesign forward apex to reflect a flat top forward heat shield cover.		-83
Redesign the forward end inner structure to increase the forward tunnel diameter and change to a single point attach for the earth landing system.		-56
Redesign crew compartment heat shield to improve Station 43 frame design and to reduce the quantity of heat shield panels.		-15
Redesign forward heat shield thruster installation.		-10
Redesign side access hatch for crew transfer and design improvement.		-24
Redesign Launch Escape System attachment to the forward end of the Command Module.		-29

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POTENTIAL WEIGHT CHANGES

COMMAND MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
STABILIZATION & CONTROL	(-)	(-34)
Utilize magnesium in lieu of aluminum on ECA base plates.		-25
Change internal package connectors from Amphenol to Cannon based on recent connector optimization study.		-9
GUIDANCE & NAVIGATION		(-100)
Incorporate simplified G & N system for Block II vehicles.		-100
CREW SYSTEMS	(+10)	(-100)
Change in crew and metabolic criteria based on astronaut data and new NASA metabolic rates.		
Crew		-49
Food and Containers		-12
Increase in-flight maintenance tool set and flight kit recovery set per layout drawings and vendor estimates.	+10	+10
Delete PLSS from Command Module per NASA TWX W8977MA (4 November 1963)		-45
Decrease mission duration from 14 days to 9 days:		
Food and Containers		-29
Increase survival kit based on latest estimates.		+25
ENVIRONMENTAL CONTROL SYSTEM	(-)	(-67)
Reduce lithium hydroxide and container per change in Crew and Metabolic criteria based on astronaut data and new NASA metabolic rates.		-18
Reduce quantity requirements of lithium hydroxide due to mission duration decrease from 14 days to 9 days.		-40
Delete two lithium hydroxide charges by raising the maximum allowable CO_2 content.		-9

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POTENTIAL WEIGHT CHANGES

COMMAND MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
EARTH LANDING SYSTEM	(-)	(-100)
Incorporate Block II configuration reducing main parachute design "q" from 64 to 45-50 "q" thereby reducing design limit load from 24K to 18K.		-100
INSTRUMENTATION	(+34)	(+34)
Increase electrical provisions based on current Airframe 011 wiring list.	+34	+34
ELECTRICAL POWER SYSTEM	(-)	(+71)
Increase electrical Command Module to Service Module umbilical consistent with potential intermodular wiring requirement.		+85
Decrease inverters due to redesign of power transistors.		-14
REACTION CONTROL	(+19)	(+19)
Increase electrical provisions based on current Airframe 011 wire lists.	+19	+19
COMMUNICATION	(-11)	(-84)
Repackage PCM components		-18
Utilize Conic Corporation VHF/FM and unmodular HF.		-8
Utilize Rantec Multiplexer.		-7
Decrease spares per reliability studies.	-11	-11
Relocate VHF/2 KMC Antenna to the Service Module.		-40
CONTROLS & DISPLAYS	(+12)	(+13)
Addition of Service Module temperature control system.	+12	+13

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POTENTIAL WEIGHT CHANGES

COMMAND MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
SCIENTIFIC EQUIPMENT	(-)	(-170)
Remove from Lower Equipment Bay.		-35
Remove from Right Hand Equipment Bay.		-135
TOTAL POTENTIAL WEIGHT CHANGES - COMMAND MODULE	+283	-701

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POTENTIAL WEIGHT CHANGES

SERVICE MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
STRUCTURE	(+125)	(-75)
Increase honeycomb bonding due to a change in adhesive bonding specification for the Apollo spacecraft requiring increases in the bonding thicknesses in the splicing areas.	+100	+ 100
Increase engine mount and backup structure due to engine stiffness requirements.	+25	+25
Decrease basic structure and equipment supports due to modifications to save weight.		-200
ENVIRONMENTAL CONTROL	(+92)	(+230)
Addition of S/M temperature control system to provide required heating or cooling to the Reaction Control System and Service Propulsion Systems.	+92	+230
ELECTRICAL POWER	(+50)	(-81)
Reduce H_2 for 9 day mission in lieu of 14 day.		-12
Reduce O_2 for 9 day mission in lieu of 14 day.		-192
Decrease in Fuel Cell Power System based on folded fuel cell design.		-50
Increase fuel cell reactants for 660 kw-hrs.		+58
Increase electrical Command Module to Service Module umbilical consistent with potential intermodular wiring requirement.		+65
Add Service Module distruct system.	+50	+50

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POTENTIAL WEIGHT CHANGES

SERVICE MODULE

ITEM	AIRFRAME 011	LOR SPACECRAFT
PROPULSION	(-)	(+85)
Add tank slosh baffles or screens.		+150
Reduce SPS propellant tank gauge.		-65
COMMUNICATIONS	(-)	(+40)
Relocate the VHF/2KMC Antenna from the Command Module		+40
TOTAL POTENTIAL WEIGHT CHANGES - SERVICE MODULE	+267	+199

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POTENTIAL WEIGHT CHANGES

LAUNCH ESCAPE SYSTEM

ITEM	AIRFRAME 011	LOR SPACECRAFT
Reduce tower insulation based on redefined boost and re-entry heating rates.	-70	-70
Add a full boost protective cover that will be jettisoned simultaneously with the LES.		+325
TOTAL POTENTIAL WEIGHT CHANGES - LAUNCH ESCAPE SYSTEM	-70	+255

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POTENTIAL WEIGHT CHANGES

ADAPTER

ITEM	AIRFRAME 011	LOR SPACECRAFT
Increase honeycomb bonding due to a change in adhesive bonding specification for the Apollo spacecraft requiring increases in the bonding thicknesses in the splicing area.	+65	+200
TOTAL POTENTIAL WEIGHT CHANGES - ADAPTER	+65	+200

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

SUMMARY

ITEM		CURRENT WEIGHT 3-1-64
WEIGHT EMPTY		8502
Structure	4699	
Stabilization & Control	226	
Guidance & Navigation	431	
Crew Systems	387	
Environmental Control	281	
Earth Landing System	705	
Instrumentation	264	
Electrical Power	519	
Reaction Control	339	
Communications	352	
Controls & Displays	299	
USEFUL LOAD		1538
Scientific Equipment	250	
Crew Systems	868	
Reaction Control	270	
Environmental Control	150	
GROSS WEIGHT		10040

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DETAIL WEIGHT STATEMENT
COMMAND MODULE
STRUCTURE

ITEM		CURRENT WEIGHT 3-1-64
STRUCTURE		
Inner Structure		(1056)
Forward Section		203
Honeycomb	63	
Frames, Rings, Hatches & Mechanism	57	
Fittings & Attachments	83	
Center Section		664
Honeycomb Panel	196	
Longerons, Frames & Rings	263	
Windows, Hatches & Mechanism	104	
Fittings & Attachments - H.S.	101	
Aft Section		189
Honeycomb Panel	110	
Ring & H.S. Attach	79	
Secondary Structure		(574)
RH Equipment Bay & Coldplates		84
LH Equipment Bay		80
Fwd. LH Equipment Bay		20
Fwd. RH Equipment Bay & Coldplates		19
Main Display Panel & Coldplates		60
Lower Equipment Bay & Coldplates		200
Aft Equipment Bay		63
Crew Area		5
Heat Shield Equipment Area		43
Heat Shield Substructure		(1429)
Forward Section		195
Honeycomb Panels & Closeouts	109	
Frames, Rings & Access. Doors	35	
Fittings, Attach & Mechanism	51	
Center Section		705
Honeycomb Panels & Closeouts	247	
Frames and Rings	114	
Access Doors, Windows & Hatch Covers	186	
Fittings, Mechanism &Attach. H.S.	134	
Air Vent	24	
Aft Section		529
Honeycomb Panels & Closeouts	350	
Frames & Rings	47	
Fittings & Attach H.S.	84	
Toroidal Assembly	48	
Ablation Material		(1273)
Forward Section		116
Center Section		529
Aft Section		628
Insulation		(195)
Separation Provisions and Attachments		(22)
LEM Docking		(150)
TOTAL STRUCTURE		4699

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

STABILIZATION AND CONTROL

ITEM	CURRENT WEIGHT 3-1-64
STABILIZATION AND CONTROL	
Lower Equipment Bay	(171.7)
Rate Gyro Package	7.5
Body Mounted Gyro Package	12.8
Electronic Control Package - Pitch	29.0
Electronic Control Package - Roll	28.3
Electronic Control Package - Yaw	28.2
Electronic Control Package - Auxiliary	29.2
Display/BMAG ECA Package	36.7
Spares - Lower Equipment Bay	(14.5)
Spare Gyro - BMAG (2)	2.0
Spare Gyro - Rate	.5
Spare Plug-In Module	12.0
Electrical Provisions	(39.8)
Wiring, etc.	39.2
SCS Power, Junction Box	.6
TOTAL STABILIZATION AND CONTROL	226.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

GUIDANCE & NAVIGATION

ITEM	CURRENT WEIGHT 3-1-64
GUIDANCE AND NAVIGATION	
Electronic Equipment	(270.9)
Inertial Measurement	60.2
Navigation Base	27.2
Computer & Spare Tray	70.0
Computer Stored Spares	25.0
Power Servo Assembly	59.4
Coupling Display Unit	16.5
Bellows Assembly	12.6
Optical Equipment	(45.8)
Sextant	12.0
Telescope	9.0
Optical Base	21.0
Optical Eyepieces	3.8
Coolant Hoses	(1.0)
Electrical Provisions	(67.5)
Cabling MIT	43.2
Cabling NAA	24.3
Loose Stored Items	(45.8)
Film Cartridges (4)	3.0
Computer Loose Spares	17.3
Power Servo Assembly Loose Spares	16.7
CDU Spare Gear Box	3.0
Spare Relay & Diode Module	.3
Eye Relief Eyepiece	1.5
Horizon Photometer	4.0
TOTAL GUIDANCE AND NAVIGATION	431.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

CREW SYSTEMS

ITEM	CURRENT WEIGHT 3-1-64
CREW SYSTEMS	
Crew Accessories	(5.0)
Case Assembly - Map & Manual	2.0
Egress Accessories - Hatch	3.0
Crew Couch/Seat & Restraint System	(373.0)
Pad Assembly Couch	7.0
Harness Assembly - Restraint	12.0
Restraint Assembly - Rest Station	4.0
Restraint Assembly - Lower Equipment Bay	2.0
Structure - Lock & Release	260.0
Structure - Support & Attenuation	87.0
Constant Wear Garment Stowage	1.0
Food & Associated Equipment	(6.9)
Shelf Assy. - Work/Food Preparation	1.9
Food Storage Boxes	5.0
Waste Management System	(2.1)
TOTAL CREW SYSTEMS	387.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

ENVIRONMENTAL CONTROL SYSTEM

ITEM	CURRENT WEIGHT 3-1-64
ENVIRONMENTAL CONTROL SYSTEM	
Pressure Suit Circuit	(88.5)
Subcontractor Compressor, Heat Exchg., Val. & Cont.	70.8
Ducting, Conn., Clamps, & Compr. Sel. Sw.	15.7
CO_2 Sensor	2.0
Water-Glycol Circuit	(60.5)
Subcontractor Res., Evaporator, Pump, Val. & Cont.	31.4
Water-Glycol	18.4
Plumbing & Glycol Pump Sel. Sw.	10.7
Pressure & Temp. Control	(19.1)
Subcontractor Heat Exchg., Blower, Val. & Cont.	18.1
Ducting & Cabin Blower Sel. Sw.	1.0
Oxygen Supply System	(15.7)
Subcontractor Val. & Cont.	5.0
Plumbing	3.5
Oxygen Surge Tank	7.2
Water Supply System	(27.3)
Subcontractor Potable & Waste Tanks	24.2
Plumbing	3.1
Subcontractor Common Items	(24.9)
Brackets, Plumbing, Elect. Wiring	12.5
Instrumentation	12.4
S&ID Common Items	(26.2)
Nitrogen Purge System	2.8
Supports	11.7
Electrical Provisions	8.1
Manual Control - Push Pull	3.6
Waste Management System	(18.8)
TOTAL ENVIRONMENTAL CONTROL SYSTEM	281.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

EARTH LANDING SYSTEM

ITEM	CURRENT WEIGHT 3-1-64
EARTH LANDING SYSTEM	
Parachute System	(590.5)
Drogue Chute System	79.6
Main Cluster	426.7
Disconnect Main Cluster	3.1
Pilot Chute System	30.6
Sequence Control	8.5
Attach Provisions	42.0
Location Aids	(6.3)
Forward Heat Shield Release System	(52.5)
Drogue Disconnect Installation	(9.6)
Electrical Pyrotechnic Initiation Provisions	(6.0)
Crushable Honeycomb - Impact Attenuation	(40.1)
TOTAL EARTH LANDING SYSTEM	705.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

INSTRUMENTATION

ITEM	CURRENT WEIGHT 3-1-64
INSTRUMENTATION	
Remote Equipment	(47.0)
Sensors	35.0
Nuclear Radiation Detection Provisions	6.0
TV Camera	4.5
TV Viewfinder	1.5
Lower Equipment Bay	(58.7)
PCM Unit No. 1	26.6
PCM Unit No. 2	21.1
Nuclear Radiation Detection Equipment	11.0
Right Hand Bay Forward	(36.0)
Inflight Test System	
Comparators and Tower Supply	16.5
Lamps	1.9
Switches	1.5
Meter	1.0
Chassis	9.0
Harness	4.1
Access Cable	2.0
Electrical Provisions	(122.3)
Inflight Test Electrical Provisions	22.0
Data Distribution Panel	2.3
Instrumentation Electrical Provisions	98.0
TOTAL INSTRUMENTATION	264.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

ELECTRICAL POWER

ITEM	CURRENT WEIGHT 3-1-64
ELECTRICAL POWER	
Energy Source	(77.8)
Battery - Re-Entry (2)	44.2
Battery - Post Landing (1)	22.1
Battery - Pyrotechnic - Installation	10.0
Battery Vent System	1.5
Power Conversion	(121.0)
Inverter (3) & Control	117.0
Battery Charger & Controls	4.0
Power Distribution & Control	(110.5)
D-C Power Panel Assy	7.6
A-C Power Box Assy	10.5
Battery Circuit Breaker Panel	3.4
Lower Equipment Bay Panel	5.4
Terminal Distribution Panel (Bus)	9.6
Circuit Breaker Panel	4.7
Electrical Transmission (Wiring, Connectors, Cond., Sup.)	50.3
Ground Power Provisions	6.0
Power Control Panel Connectors	3.0
Installation Provisions	10.0
Electrical Common Utility	(199.4)
Electrical Transmission (Wiring, Conn., Cond., & Sup.)	78.4
Right Hand Circuit Breaker Panel	17.1
Left Hand Circuit Breaker Panel	10.9
Lighting	3.0
Adapter Separation System	2.5
LES Separation System	18.1
S/M Pyrotechnic Initiation	3.0
Circuit Utilization Package	6.6
Sequencer	39.1
Installation Provisions	13.5
C/M to S/M Separation System Wiring & Hardware	7.2
Lighting Equipment	(10.3)
TOTAL ELECTRICAL POWER	519.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

REACTION CONTROL SYSTEM

ITEM		CURRENT WEIGHT 3-1-64
REACTION CONTROL SYSTEM		
Propellant System		(73.5)
Oxidizer System		37.2
Tanks & Expulsion Devices	15.0	
Plumbing, Fittings & Insulation	11.4	
Valves & Regulators	10.3	
Sensors	.5	
Fuel System		36.3
Tanks & Expulsion Devices	14.1	
Plumbing, Fittings & Insulation	11.4	
Valves & Regulators	10.3	
Sensors	.5	
Pressure System		(55.4)
Tanks (4500 psi)		9.5
Plumbing, Fittings & Insulation		4.8
Valves & Regulators		38.6
Sensors		2.5
Engine System		(141.6)
Engines		99.6
Nozzle Extension		42.0
Electrical Provisions		(35.7)
Dumping System		(32.8)
Valves & Supports		13.0
Controls & Electrical Provisions		12.0
Plumbing & Fittings		5.0
Miscellaneous		2.8
TOTAL REACTION CONTROL SYSTEM		339.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

COMMUNICATIONS

ITEM	CURRENT WEIGHT 3-1-64
COMMUNICATIONS	
Lower Bay	(239.3)
C-Band Transponder	20.8
Unified S-Band	30.9
S-Band Power Amplifier	17.5
VHF-FM Transmitter/HF Transceiver	15.4
VHF AM Trans. -Rec/VHF Rec. Bea.	15.1
Multiplexer	11.0
Signal Conditioner	40.0
Recorder	25.4
Audio Center	8.0
Premodulation Processor	14.2
Central Timing Equipment	8.0
Up Data Link and Provisions	24.0
VHF-HF Diplexer	1.7
VHF-UHF Diplexer	1.5
S-Band P.A. Spare Traveling Wave Tube	1.3
S-Band P.A. Spare Power Supply	4.5
Remote Equipment	(57.3)
VHF-HF Recovery Antenna & Transmission	11.4
C-Band Antenna & Transmission	11.7
2-KMC High Gain Antenna and Transmission	4.4
VHF-2 KMC Omni Ant., Trans. & Instl. Prov.	29.8
Electrical Provisions	(36.4)
Electrical Wiring	23.6
Data Distribution Panel	1.5
Coax	5.2
Connectors	6.1
Spares	(19.0)
TOTAL COMMUNICATIONS	352.0

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DETAIL WEIGHT STATEMENT
COMMAND MODULE
CONTROLS AND DISPLAYS

ITEM	CURRENT WEIGHT 3-1-64
MAIN DISPLAY PANEL	
Main Display Panel Control Station	(57.8)
SCS Mode Select	3.2
Delta Velocity	2.2
Flight Director Attitude Indicator	10.0
Attitude Set and Gimbal Position Display	4.8
SPS Gimbal Actuator	.5
Entry Monitoring Indicator	15.0
Launch Vehicle Emergency Detection System C-1	4.7
Master Caution and Abort Lt.	.3
IFTS Switch	.1
Barometric Indicator Light	.1
Event Timer	1.5
Mounting Panels	2.4
Rendezvous Radar	13.0
Main Display Panel Center Station	(61.3)
Audio Panel	1.2
Abort Light	.2
Reaction Control	11.2
GMT Readout	.8
ECS Gages and Controls	6.6
Crew Safety Controls	1.6
High Gain Antenna Control	2.6
G & N Computer Keyboard	15.0
Radiation Displays	3.0
Cryogenic	4.2
Caution and Warning Display	4.8
Mounting Panels	10.1
Main Display Panel System Management Station	(31.5)
Communications Control Panel	4.0
Master Caution Lights	.2
Power Distribution	6.1
Fuel Cells Controls	4.7
Service Propulsion	8.9
IFTS Switch	.1
Oxygen Warning	.1
Mounting Panels	7.4
Main Display Panel RH Console	(10.5)
Bus Switches	5.7
Audio Panel	1.2
Lighting Control	1.6
Mounting Panels	2.0
Main Display Panel LH Console	(7.9)
Mission Sequence Controls	1.0
Lighting Control	1.6
Audio Panel	1.2
SCS Power Control	2.2
Mounting Panels	1.9
TOTAL MAIN DISPLAY PANEL (To be brought forward)	169.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

CONTROLS AND DISPLAYS

ITEM		CURRENT WEIGHT 3-1-64
REMOTE EQUIPMENT		
Lower Equipment Bay		(48.0)
Lighting Control Panel		1.2
G & N Controls and Displays		46.8
Map and Data Viewer	8.5	
Display and Control - Navigation	23.3	
Display and Control - Computer	15.0	
Left Hand Forward Equipment Bay		(3.0)
Clock		.8
Event Timer		2.0
Mounting Panel		.2
Crew Area Controls		(18.3)
Manual Control - Rotation		9.9
Manual Control - Translational		8.4
Caution and Warning		(16.5)
Detector		14.0
Spares		2.5
Electrical Provisions		(44.2)
Electrical Wiring		43.5
SCS/G & N Display Junction Box		.7
TOTAL REMOTE EQUIPMENT		130.0
TOTAL MAIN DISPLAY PANEL		169.0
TOTAL CONTROLS AND DISPLAYS		299.0

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COMMAND MODULE

USEFUL LOAD

ITEM	CURRENT WEIGHT 3-1-64
CREW SYSTEMS	
Government Furnished Equipment	(144.0)
Pressure Garment Assembly (3)	79.2
Portable Life Support System (1)	42.0
Garments - Constant Wear	9.0
Biomedical Instrumentation	2.0
Personal Radiation Dosimeters	11.8
Crew (50, 70, 90 Percentile)	(528.0)
Food and Associated Equipment	(83.5)
Food	67.5
Food Containers	12.5
Food Mouthpiece - Personal	2.0
Water Delivery Assembly - Personal	1.5
Crew Accessories	(8.0)
Lap Board Assembly	2.0
Manual Set	3.0
Map Set	1.0
Logbook Assembly	1.0
Tool Set - Inflight Maintenance	1.0
Crew Equipment	(26.2)
Shoe Straps	2.0
Hose Assembly - Umbilical	17.9
Belt Assembly - Inflight Maintenance	1.0
Hose Assembly - Recharging, Backpack	2.8
Suit Electrical Umbilical and Wire	2.5
Waste Management	(2.5)
Medical Equipment	(12.1)
Personal Hygiene Equipment	(15.6)
Light Assembly - Portable	(3.0)
Provisions Assembly - Crew Survival	(42.1)
Personal Communications	(3.0)
TOTAL CREW SYSTEM (To be brought forward)	868.0

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DETAIL WEIGHT STATEMENT

COMMAND MODULE

USEFUL LOAD

ITEM		CURRENT WEIGHT 3-1-64
REACTION CONTROL		(270.0)
Usable Propellant		225.0
Residual Propellant		44.0
Trapped - System	30.8	
Mixture Ratio	2.7	
Expulsion Efficiency	7.8	
Loading Tolerance	2.7	
RCS Helium		1.0
ENVIRONMENTAL CONTROL		(150.0)
Lithium Hydroxide		112.0
Activated Charcoal		4.0
Containers for LiOH & Charcoal		12.8
Oxygen - Re-Entry		3.7
Water-Earth Orbit Cooling & Drinking		3.5
Water-Boost Cooling		4.0
Water-Emergency Re-Entry Cooling		6.0
Chemical Disinfectant		4.0
SCIENTIFIC EQUIPMENT		(250.0)
TOTAL This page		670.0
TOTAL CREW SYSTEM (Brought forward from Page)		868.0
TOTAL USEFUL LOAD		1538.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

SUMMARY

ITEM		CURRENT WEIGHT 3-1-64
WEIGHT EMPTY		(7720)
Structure	2290	
Environmental Control	92	
Instrumentation	113	
Electrical Power	1389	
Propulsion	3063	
Reaction Control System	602	
Communications	51	
Rendezvous Radar	120	
USEFUL LOAD		(2230)
Reaction Control	838	
Electrical Power	503	
Environmental Control	208	
Propulsion	681	
BURNOUT WEIGHT		9950
MAIN PROPELLANT		38075
GROSS WEIGHT		48025

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

STRUCTURE

ITEM	CURRENT WEIGHT 3-1-64
STRUCTURE	
Basic Body Structure	(1616)
Honeycomb Panels	561
Frame and Rings	6
Access Doors	15
Fittings and Attach Parts	48
Radial Beams	373
Internal Partitions	25
Forward Bulkhead	161
Aft Bulkhead	305
RCS Panels	122
Secondary Structure	(185)
Tank Support Shelf	29
Engine Support Structure	54
Antenna Support Structure	50
Aft Heat Shield	52
Insulation	(299)
Separation Provisions and Attachments	(16)
Fairing - C/M to S/M	(144)
Miscellaneous	(30)
TOTAL STRUCTURE	2290

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

ENVIRONMENTAL CONTROL SYSTEM

ITEM	CURRENT WEIGHT 3-1-64
ENVIRONMENTAL CONTROL SYSTEM	
Water-Glycol Circuit	(80.3)
Subcontractor Valves & Controls	9.7
Plumbing and Hardware	23.3
Water - Glycol	10.0
Space Radiator (Outer Skin)	37.3
Water Supply System	(6.6)
Plumbing and Hardware	6.6
Oxygen Supply System	(3.0)
Plumbing and Supports	3.0
Common Items	(2.1)
Supports	1.6
Subcontractor Miscellaneous Supports	.5
TOTAL ENVIRONMENTAL CONTROL SYSTEM	92.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

INSTRUMENTATION

ITEM	CURRENT WEIGHT 3-1-64
INSTRUMENTATION	
Instrumentation Sensors	(30.0)
Electrical Provisions	(78.0)
Supports	(5.0)
TOTAL INSTRUMENTATION	113.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

ELECTRICAL POWER

ITEM	CURRENT WEIGHT 3-1-64
ELECTRICAL POWER	
Fuel Cell Power System	(1195.9)
Fuel Cell Power Pack (Incl. Mount Instrumentation)	738.6
Intermodular - Radiator Plumbing	31.3
Fuel Cell Module Mount Attach	1.1
Fuel Cell H_2 System	
Subcontractor Components	153.2
Plumbing and Valves	5.5
Fuel Cell and ECS O_2 System	
Subcontractor Components	168.2
Plumbing and Valves and Supports	31.7
Water Glycol - Fuel Cell Heat Transfer System	7.0
Elect. Wiring - Supercritical Gas	3.7
Space Radiator (Outer Skin)	40.5
Fuel Cell Module Stabilization Webs	3.8
Fuel Cell Plumbing Supports	6.0
Valve Module Control Box (Cryogenic Gas)	5.3
Power Distribution	(83.5)
Electrical Transmission	52.7
Power Distribution Box	30.8
Electrical Common Utility	(109.6)
Electrical Transmission	37.8
Sequencer	28.0
Adapter Separation System	1.4
C/M to S/M Separation System	12.5
Pyrotechnic Initiation	12.0
Provisions	10.5
LES Separation System Wiring & Hardware	7.4
TOTAL ELECTRICAL POWER	1389.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

MAIN PROPULSION

ITEM		CURRENT WEIGHT 3-1-64
MAIN PROPULSION		
Propellant Systems		(1395.0)
Oxidizer System		779.3
Tanks & Doors	557.0	
Skirts	59.8	
Plumbing, Fittings & Insulation	53.0	
Valves	4.5	
Quantity Indication	25.5	
Mixture Ratio Control	14.0	
Supports - Plumbing & Equipment	43.5	
Retention Reservoir	22.0	
Fuel System		615.7
Tanks & Doors	458.0	
Skirts	33.2	
Plumbing, Fittings & Insulation	42.0	
Valves	4.5	
Quantity Indication	25.5	
Supports - Plumbing & Equipment	31.5	
Retention Reservoir	21.0	
Pressure System		(925.0)
Tanks (4400 psi)		784.0
Tanks Supports		30.0
Plumbing, Fittings & Insulation		24.0
Valves, Regulators & Heat Exchanger		49.0
Supports - Plumbing & Equipment		38.0
Engine System		(712.0)
Engine		687.0
Closeouts - Throat to S/M		25.0
Electrical Provisions		(31.0)
TOTAL MAIN PROPULSION SYSTEM		3063.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

REACTION CONTROL

ITEM		CURRENT WEIGHT 3-1-64
REACTION CONTROL SYSTEM		
Propellant Systems		(186.4)
Oxidizer System		95.1
Tanks & Expulsion Devices	34.4	
Plumbing, Fittings & Insulation	8.5	
Valves & Regulators	12.0	
Sensors	3.0	
Supports	18.2	
Quantity Gaging	19.0	
Fuel System		91.3
Tanks & Expulsion Devices	31.6	
Plumbing, Fittings & Insulation	8.5	
Valves & Regulators	12.0	
Sensors	3.0	
Supports	18.2	
Quantity Gaging	18.0	
Pressure System		(128.0)
Tanks (4500 psi)		19.0
Plumbing, Fittings & Insulation		6.0
Valves & Regulators		76.0
Sensors		7.0
Supports		20.0
Engine System		(175.2)
Engines		75.2
Reflectors & Insulation		100.0
Structural Provisions		(80.0)
Electrical Provisions		(32.4)
TOTAL REACTION CONTROL SYSTEM		602.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

COMMUNICATIONS

ITEM	CURRENT WEIGHT 3-1-64
COMMUNICATIONS	
Remote Equipment	(39.0)
Gimbal - High Gain Antenna	12.2
Earth Sensor - High Gain Antenna	12.0
High Gain Antenna	4.8
Locking Provisions - High Gain Antenna	3.0
Boom - High Gain Antenna	7.0
Electrical Provisions	(11.0)
Wiring - Common Utility	2.0
Coax & Connectors - High Gain Antenna	9.0
Supports	(1.0)
TOTAL COMMUNICATIONS	51.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

RENDEZVOUS RADAR

ITEM	CURRENT WEIGHT 3-1-64
RENDEZVOUS RADAR	
Rendezvous Equipment	(69.8)
Radar Package	30.0
X-Band Dish Ant., Trans. & Sup.	17.8
Antenna Boom	10.0
Antenna Actuation Mechanism	10.0
Diplexer	2.0
Transponder Equipment	(28.6)
Transponder	10.0
X-Band Flush Mntd. Omni Ant. (3)	3.0
X-Band Trans. & Supports	12.6
X-Band Power Divider	1.0
Diplexer	2.0
Supports & Cooling Provisions	(15.6)
Rendezvous Equipment	9.6
Transponder Equipment	6.0
Electrical Provisions	(6.0)
Rendezvous Equipment	3.0
Transponder Equipment	3.0
TOTAL RENDEZVOUS RADAR	120.0

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DETAIL WEIGHT STATEMENT

SERVICE MODULE

USEFUL LOAD

ITEM			CURRENT WEIGHT 3-1-64
REACTION CONTROL			(838.0)
RCS Propellant			835.0
Usable		790.0	
Residual		45.0	
Trapped System	4.0		
Mixture Ratio	9.0		
Expulsion Efficiency	24.0		
Loading Tolerance	8.0		
RCS Helium			3.0
ELECTRICAL POWER (Normal Mission)			(503.0)
Hydrogen - Supercritical Gas			58.5
Usable (Electrochemical Incl. Tolerance)		46.0	
Unusable (Residual & Instrument Error)		3.2	
Emergency Provisions		4.7	
Expended (Leakage & Purge)		4.6	
Oxygen - Supercritical Gas			444.5
Usable (Electrochemical Incl. Tolerance		377.0	
Unusable (Residual & Instrument Error)		17.5	
Emergency Provisions		44.0	
Expended (Leakage & Purge)		6.0	
ENVIRONMENTAL CONTROL (Normal Mission)			(208.0)
Oxygen - Supercritical Gas			208.0
Usable (Metabolic)		76.5	
Unusable (Residual & Instrument Error)		9.1	
Emergency Provisions		25.3	
Expended (Leakage, LEM, PLSS, Repress.)		97.1	
PROPULSION			(681.0)
Main Propulsion Helium			99.0
Main Propellant Residuals			582.0
Trapped - System		225.0	
Trapped - Engine		67.0	
Mixture Ratio Tolerance		100.0	
Loading Tolerance		190.0	
TOTAL USEFUL LOAD (Less Main Propellant)			2230.0

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DETAIL WEIGHT STATEMENT

LAUNCH ESCAPE SYSTEM

SUMMARY

ITEM	CURRENT WEIGHT 3-1-64
LAUNCH ESCAPE SYSTEM	
Structure	(1033)
Tower Assy	318
Escape Motor Skirt	208
Pitch Motor Structure	162
Nose Cone and Ballast Support	113
Attaching Parts	9
Tower Insulation	198
Skirt Insulation	25
Separation Provisions	(49)
Ballast	(566)
Propulsion	(5340)
Escape Motor	4767
Jettison Motor	434
Jettison Motor Skirt	92
Pitch Control Motor	47
Electrical Power	(102)
C/M Boost Protection Cover	(185)
TOTAL LAUNCH ESCAPE SYSTEM	7275

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DETAIL WEIGHT STATEMENT

ADAPTER

SUMMARY

ITEM	CURRENT WEIGHT 3-1-64
ADAPTER	
Structure	(3330)
Basic Body Structure	
Honeycomb Panels	2237
Longerons	44
Frames & Rings	208
Access Doors	50
Fittings & Attachings Parts	50
Secondary Structure	
LEM Supports	36
Insulation	387
Separation Provisions & Attach	288
Miscellaneous	30
Electrical Provisions	(70)
TOTAL ADAPTER	3400

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